REMARKS

Claim Rejections – 35 USC § 103

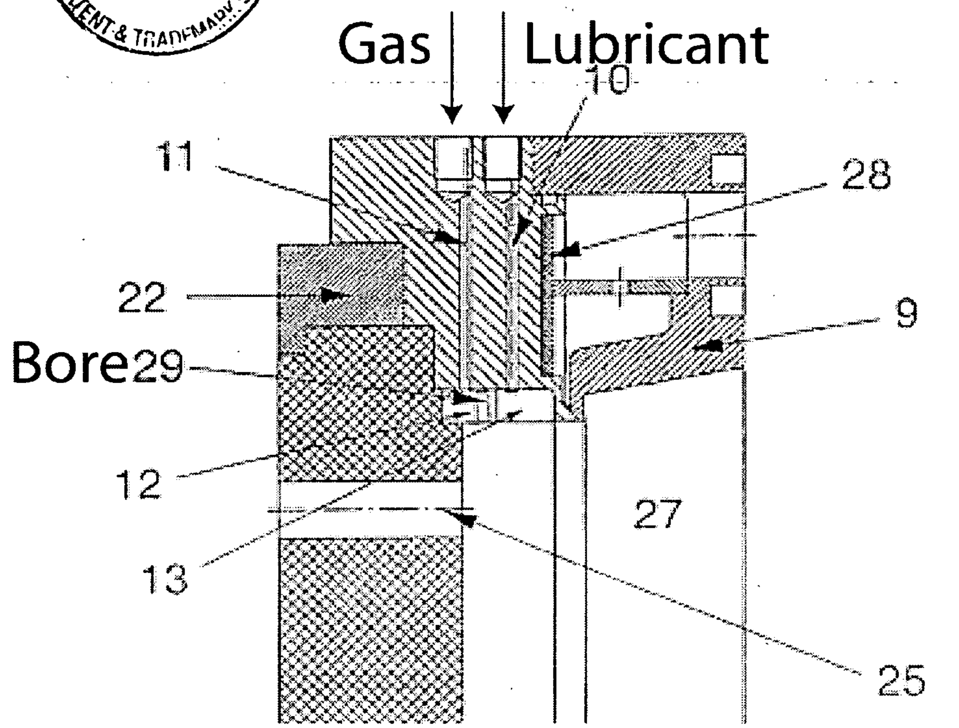
Rejection of Claims 1-4, 7, 9-10, 13, 15-22 and 30

The Examiner rejected Claims 1-4, 7, 9-10, 13, 15-22 and 30 over WO 01/00352 in view of Yanagimoto et al. Reconsideration of this rejection is requested for the following reasons.

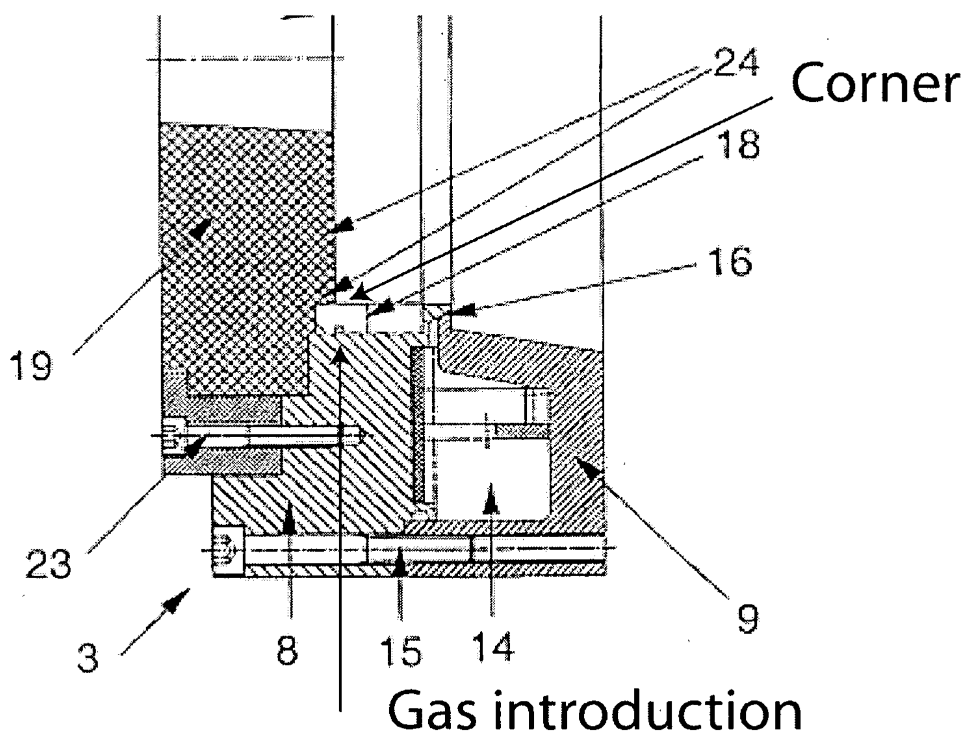
The Examiner gave an interpretation of the teaching of WO '352 as disclosing second and third conduits (using the terminology of the present application) supplying oil and gas. The Examiner then relied on Yanagimoto et al. as disclosing the first conduit for supplying gas to the corner of the shoulder, thus providing the three conduits required by Claim 2 of the present application.

However, the most reasonable interpretation of WO '352 (based on page 3, second to fourth paragraph and Fig. 2a) is that it discloses first (gas) and third (lubricant) conduits according to the terminology of the present application. This would leave no reason to combine the teaching of this reference with Yanagimoto et al. This is explained in more detail below in which parts of Fig. 2a) of WO'352 have been duplicated with the addition of text to facilitate understanding.

It is believed that the author of WO'352 intended the gas to be introduced through conduit 11 and the oil (lubricant) to be introduced through conduit 10. This is because the reference mentions the presence of a bore 29 "to enable drainage of excess gas and thereby avoid inclusion of gas in the cast metal product" (page 3, lines 17 and 18). If gas were injected through conduit 10, the injected gas would have to move counter to the flow of molten metal to enter the bore 29 and thereby escape, so this direction of movement is unlikely. The gas is therefore intended to be introduced through conduit 11. This assumption is reinforced by Claim 4 of the reference which requires that "the gas is supplied through the permeable material (through 12) in the area closer to the plate 19, while the oil is supplied through the material in the area further from (through 11) the plate (19)". It should also be noted that porous wall members 12 and 13, which are fed respectively by conduits 11 and 10, are physically separated (see part 18 of Fig. 2a and paragraph 2 on page 3), thus separating the flows of gas and lubricant.



It will also be observed that conduit 11 is aligned with the corner of the shoulder and the cavity wall. This is best seen at the bottom part of Fig. 2a) of the reference:



This makes it clear that the gas is introduced in alignment with the shoulder, so there is no room for a further gas channel in alignment with the shoulder, such as one taken from Yanagimoto et al.

Not only is this the case, but WO'352 teaches away from the provision of a bubble of gas at the corner of the shoulder, such as the one provided in the present invention. This is because the bore 29 is, as mentioned above, specifically provided to remove gas that accumulates within the mold. The combination of WO'352 with Yanagimoto et al. would therefore be illogical.

Even if WO'352 does allow for the introduction of lubricant through conduit 11 and the introduction of gas through conduit 10 (which does not seem to be the case), there is still no room for the introduction of a further gas conduit leading to the corner of the mold as this position is filled by conduit 11.

A combination of WO'352 and Yanagimoto et al. as suggested by the Examiner is also illogical or inappropriate based on the overall teachings of these references.

Yanagimoto et al. discloses the injection of a gas mixture containing oxygen so as to form a protective oxide film on a highly reactive Al-Li alloy, and therefore eliminate the need for special cooling systems and other protective measures to overcome casting hazards. The Examiner notes that at least some of the embodiments of the '566 patent disclose the application of the gas via a conduit directed to the "corner" of the mold. It is important to note, however, that (a) Yanagimoto et al. does not suggest that such a conduit is in conjunction with any other gas delivery conduit (only with respect to lubricant delivery conduits), and (b) Yanagimoto et al. lists several satisfactory embodiments of the method (Column 3, line 45 to Column 4, line 36). The Examiner's attention is drawn to embodiment "B" where the gas mixture of Yanagimoto et al. may be used with a mold as described in US Patent 4,598,763 (it is assumed that the Examiner can readily obtain a copy of this patent, if needed). The mold of this patent employs a permeable wall member to deliver lubricant and gas to the sidewall of the mold, substantially in the manner disclosed in WO '352. Therefore, a person skilled in the art in reading Yanagimoto et al. along with WO '352 reference would not find any teaching that two gas conduits are advantageous. In reading Yanagimoto et al., the person skilled in the art would be drawn to the conclusion that, to achieve a satisfactory oxide surface on the ingot in the apparatus of WO'352, one would could simply substitute whatever gas was being used in conduit 11 for the gas mixture disclosed in Yanagimoto et al. There would be no reason for adding the complexity of a second gas conduit since Yanagimoto et al. teaches that simple substitution is adequate.

In the present application, the intent is to provide a casting mold that can achieve a high quality (smooth) surface. The inventors found that the two conduit delivery of gas contributed to this. The intent of Yanagimoto et al. is to produce an oxide surface sufficient to protect a highly reactive Al-Li alloy from dangerous reactions and other hazards.

The Examiner rejected Claims 9 and 10 on the basis of this same prior art. Reconsideration is requested. These Claims introduce the concept of tapered/asymmetric molds. The taper in the mold is in the contacting wall (as is evident in our Figure 3 of the present application, for example). Such a taper is neither illustrated nor disclosed in WO '352. There is a taper shown as part 27 in the Figures of WO '352, which is part of the secondary cooling section, but no taper in the wall sections 12, 13.

The Examiner further rejected Claims 19 to 21 on the basis of the same prior art. Claim 19 relates to the use of different gases at the same time (one less reactive than the other). WO '352 is silent as to the type of gas used. The Yanagimoto et al. teaches that only one gas (containing oxygen) should be used. Neither reference teaches that there would be any benefit to using two different gases delivered to the mold or that a more reactive gas would beneficially be used in one location and a less reactive gas in another.

Rejection of Claims 5-6 and 23-24

The Examiner rejected Claims 5-6 and 23-24 over WO'352 in view of Yanagimoto et al., and further in view of Thornton (US 4,668,554). Reconsideration of this rejection is requested.

Thornton teaches that an impermeable barrier disposed vertically within a porous refractory metal feed tube is effective for confining an inert gas to one side of the barrier. There seems to be little relevance of the reference to the present situation in which a barrier is chosen to keep two separate and different streams of gas isolated from each other within a porous wall element of a metal mold - not a metal feed tube positioned in the middle of the mold immersed in molten metal. It would take a considerable generalization, hence invention, to assume that Thornton could be directly useable in Yanagimoto et al. and WO '352.

Rejection of Claims 8 and 32-33

The Examiner rejected Claim 8 and Claims 32-33 over WO'352 in view of Yanagimoto et al., and further in view of Kudo et al (US '995) and McGee et al (US '346). Reconsideration of this rejection is requested.

Kudo et al. discloses a sensor for detecting the presence of low molecular weight hydrocarbon using a conductivity-based sensor. The sensor comprising a conductive polymer coating and is not based on measurement of resistance between a solid surface (e.g. mold wall) and molten metal or emerging ingot. The field of this patent is totally remote from the field of the present invention. There is no suggestion in the reference that one could use the sensor in the environment of a casting mold. Consequently one skilled in the art would not even consult Kudo et al. and would never identify within a means of sensing lubricant as required in Claims 8 and 32 to 33.

McGee et al. discloses a sensor for detecting metal particles in an oil (e.g. transmission fluid) based on a measurement of conductivity. It appears that the measured conductivity is related to the amount of solid metal particles present and not the presence or absence of lubricant between a solid mold and emerging ingot. Once again the field of this patent is totally remote from the field of the present invention. It cannot be envisaged how such a device would be used to measure the conductivity between mold and molten metal or emerging ingot as required by Claim 8, etc.

Rejection of Claims 11 and 28

The Examiner rejected Claim 11 and Claim 28 over WO'352 in view of Yanagimoto et al., and further in view of Ohno. Reconsideration is requested.

Ohno teaches a horizontal casting mold that is essentially open-topped mold (see, for example, Col 2, lines 23 to 39) for monitoring and gas release purposes. In addition, the design affects the direction of solidification. There is nothing that teaches that such a trough-like mold would produce a circular cross-section ingot as asserted by the Examiner and therefore use of this mold would not be contemplated for the present invention. The mold is said to be useful for sheet and wire rod casting. Neither of these are necessarily circular in cross-section (sheet, of course, most certainly is not). Furthermore, it is clear that the mold of Ohno is open-topped. The present mold as claimed in Claim 1 (on which Claims 11 and 28 depend) includes at least one annular member (e.g. the first annular wall means) and therefore the present invention would not constitute an open topped mold as required for the Ohno mold to function.

Rejection of Claims 12 and 29

The Examiner rejected Claim 12 and Claim 29 over WO'352 in view of Yanagimoto et al., and further in view of Kittilsen et al. Reconsideration is requested.

The Examiner is correct in that Kittilsen et al. does disclose an asymmetrically positioned inlet. This is common in mold designs of the type disclosed in Kittilsen et al. It should be noted that Claim 12 of the present application is dependent on Claim 11 and Claim 29 is dependent on Claim 28. Neither Claim 11 nor 28 were found to be obvious based solely on the two principal references so that the Examiner would actually have to combine four references to arrive at the subject-matter of these Claims. The rejection of Claims 11 and 28 is incorrect for the reasons given above. Kittilsen teaches that asymmetry of the injection point is required to achieve proper thermal distribution not a circular cross-section (see Col. 3, lines 38 to 42), so even if the rejection of Claims 11 and 28 were correct (which Applicant denies), a person skilled in the art would not, based on this reference, contemplate making the inlet position asymmetric to make the resulting ingot circular.

Rejection of Claim 14

The Examiner rejected Claim 14 over WO'352 in view of Yanagimoto et al., and further in view of Foyle et al. Reconsideration is requested.

Applicant cannot see any mention of staggered discharge locations and variation of opening sizes and discharge angles around the mold as required by this Claim. The section cited by the Examiner mentions problems of differential heat transfer around the mold but this cannot be interpreted as teaching the features of Claim 14. In fact such differential behaviour is specifically attributed in the same section to problems of lubrication <u>not</u> coolant distribution. The Examiner is requested to provide more specific details or withdraw the rejection.

Rejection of Claims 26-27

The Examiner rejected Claim 26 and Claim 27 over WO'352 in view of Yanagimoto et al., and further in view of Richards et al. Reconsideration is requested.

Richards et al. teaches that the gaseous agent reacts with the aluminum surface (see Col 3, lines 1 to 4) not with a second gas (i.e. the gas in the pocket) as required in Claim 27 and therefore the reaction as contemplated in Claim 27 would not be deduced from this reference.

Rejection of Claim 31

The Examiner rejected Claim 31 over WO'352 in view of Yanagimoto et al., and further in view of Flowers et al. Reconsideration is requested.

Flowers et al. is in the field of continuous strip casting using roll casting whereas the present invention is in the field of continuous casting of billet in a fixed open-ended mold using "direct chill casting" or the application of the coolant to the surface of the emerging billet. It is well known in the art that the continuous strip casting by roll casting produces high cooling rates (e.g. in excess of 100°C/sec) by applying a load via the rolls to the solidifying strip and by casting thin strips. This is a substantially different method of cooling than applying a coolant spray as in DC casting. It is known that roll casting typically operates in a cooling rate regime much higher than direct chill casting in fixed open ended molds. Therefore a person skilled in the art would not consider using a roll casting result, obtained via a totally different method of casting to operate a direct chill casting mold and therefore the combination of references proposed by the Examiner does not render the Claim obvious.

Rejection of Claims 34 and 35

Finally the Examiner rejected product Claims 34 and 35 as anticipated (or rendered obvious) by Flowers et al. Applicant finds the logic for this rejection rather confusing. The Examiner notes first that the reference teaches the desirability of having a hard disc of low surface roughness, and attributes this to the achievement of a fine grain structure within the cast product with less than 1 micron dendrite arm spacing (DAS). Applicant believes that the Examiner has made some errors in interpreting the reference. Firstly, the reference (e.g. Col. 1, lines 49 to 53) is quite clear that a hard disc, not an as-cast material, is the end result of applying several polishing and finishing steps to the alloy material. Once this finishing is done, the disc has a low roughness that permits the head to ride within 1 micron of the disc. This low roughness of the product manufactured from the cast material does not permit any particular conclusion to be drawn about the as-cast product. The disclosure (in the same section) does teach that good uniformity of chemistry, mechanical properties and microstructure are needed to allow such a low roughness product to be manufactured after a number of additional steps are performed, but makes no statement about roughness of the as-cast material. The Examiner asserts that the DAS of the as-cast material is less than 1 micron, but although Col. 8, line 67 states that the DAS is "fine", it is not quantified in any way except by the reasoning of the Examiner, which is not believed to be appropriate.

The Examiner then draws the conclusion that a billet product would have the same microstructure and DAS and that it would have a low surface roughness. This further ignores

that the product of Flowers et al. is a cast strip produced by roll casting rather than a billet produced by DC casting.

Therefore, Flowers et al. discloses neither a cast billet nor a cast billet having a low surface roughness, and the present Claims cannot be considered anticipated. With respect to obviousness, it was noted in connection with Claim 31, that a person skilled in the art appreciates the significant difference between the continuous strip casting process and direct chill casting, and therefore the fact that strip casting by a roll caster produces a product having a particular uniformity and DAS does not permit one to draw any conclusions about a product of direct chill casting. As already noted, the Examiner has cited the roughness of a product that is the end result of several processing steps after casting which says nothing about the surface roughness of the casting (either of a strip by roll casting or even more so of a billet by direct chill casting).

It is therefore believed that Flowers et al. is not relevant to the subject matter of Claims 34 and 35.

In view of the above, favorable reconsideration of this application is requested.

Respectfully,

Christopher C. Dunham

Christopher C. Dunham
Reg. No. 22,031
Attorney for Applicants
Tel. (212) 278-0400

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Christopher C. Dunham

Christopher C. Dunham
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